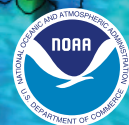# Windows to the Deep 2019: Exploration of the Deep-sea Habitats of the Southeastern United States (EX1903 Legs 1 & 2)

NOAA Ship *Okeanos Explorer*
May 30 – July 12, 2019
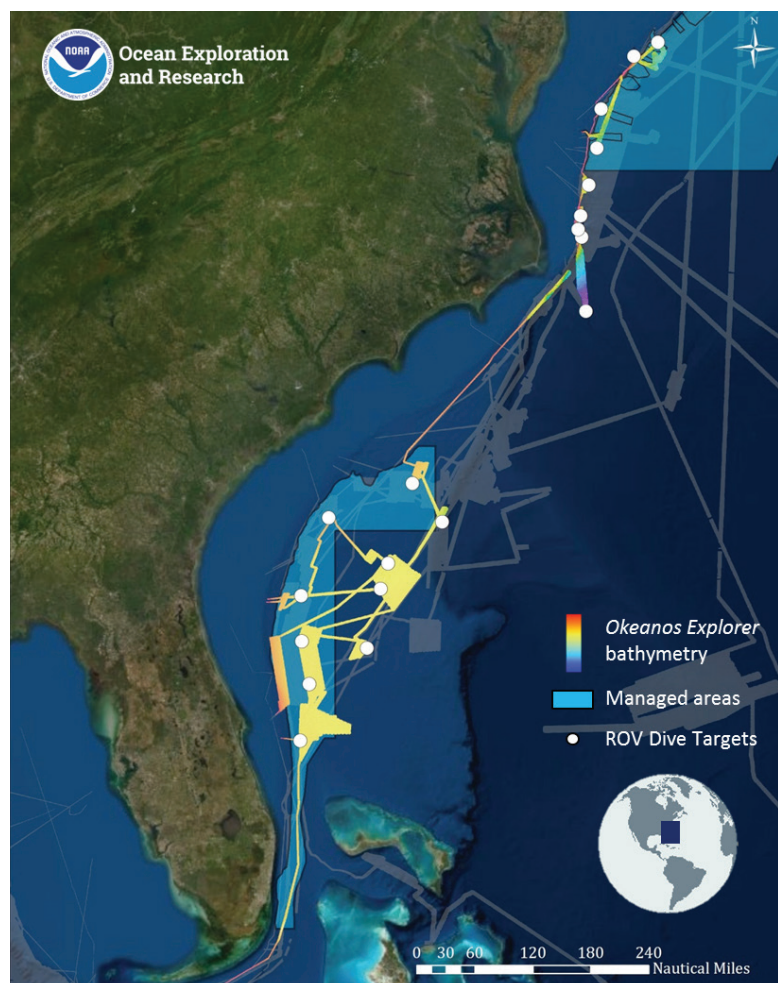
ASPIRE

NOAA **Ocean Exploration and Research**

Windows to the Deep 2019: Exploration of the Deep-sea Habitats of the Southeastern United States was one of several expeditions being conducted from NOAA Ship *Okeanos Explorer* as part of the Atlantic Seafloor Partnership for Integrated Research and Exploration (ASPIRE) campaign, a major multi-year, multi-national collaborative field program focused on raising collective knowledge and understanding of the North Atlantic Ocean.

Expedition Summary

The **Windows to the Deep 2019: Exploration of the Deep-sea Habitats of the Southeastern United States** (EX1903 Legs 1 and 2) was a 38-day telepresence-enabled expedition to collect critical information and acquire data on priority exploration areas identified by the ocean management and scientific communities. This expedition involved exploration of a diversity of features across the southeast and mid-atlantic U.S. continental margin with mapping and remotely operated vehicle (ROV) operations. Target areas were those with potential to host deep-sea coral and sponge communities, submarine canyons, and methane seep sites, as well as landslide, slump, and scarp features. Mapping data collected during this expedition filled data gaps in the region and will contribute to Seabed 2030 goals for mapping unexplored regions of Earth's oceans. Leg 2 of the **Windows to the Deep 2019** expedition marked the 100th mission that ocean exploration data was collected from NOAA Ship *Okeanos Explorer*, a celebratory achievement credited to the shore-side and seagoing teams that participated in the last decade of expeditions, and to NOAA's commitment to ocean exploration! Major accomplishments of this expedition are summarized below.

Map of the **Windows to the Deep 2019** expedition overlaid with past data collected by NOAA OER onboard NOAA Ship *Okeanos Explorer* from 2011 to 2018. *Map courtesy of the NOAA Office of Ocean Exploration and Research.*

Conducted 19 ROV dives ranging in depth from 298 to 3,490 meters (978-11,450 feet) to improve knowledge of unexplored areas within the U.S. Exclusive Economic Zone (EEZ) to inform management needs for sensitive habitats, maritime heritage sites, and potential resources. Data collected can be used to increase understanding of deep-sea ecosystem connectivity across the Atlantic basin.

- Conducted six ROV dives and mapping operations in the Stetson Miami Terrace Deep Coral Habitat Area of Particular Concern (HAPC).
  - Mapped over 14,000 square kilometers (5,405 square miles) in the HAPC, bringing the total OER-supported bathymetry collection since 2011 within the HAPC to 34,037 square kilometers (13,142 square miles).
  - Expanded our knowledge of the "Million Mounds" region of the Stetson Miami Terrace Deep Coral HAPC, an area nicknamed for the numerous mounding features that comprise one of the largest areas of deep-sea coral reef habitat that have been discovered in U.S. waters to date. The two legs of EX1903 gathered additional bathymetry over the "Million Mounds" region of the HAPC, and revealed the first indication of an eastern boundary of this habitat. ROV exploration revealed extensive deep-sea coral and sponge habitat, including five sites with highly diverse communities.
- Conducted the first mapping and ROV exploration of a portion of the central Blake Plateau where previously unknown mounding features were revealed. Two ROV dives documented expansive live coral communities, and confirmed that these features were likely created by the accumulation of *Lophelia pertusa* skeletal matrix over time. Prior to this expedition, this area of the Plateau was thought to be flat, featureless, and composed primarily of soft sediment.
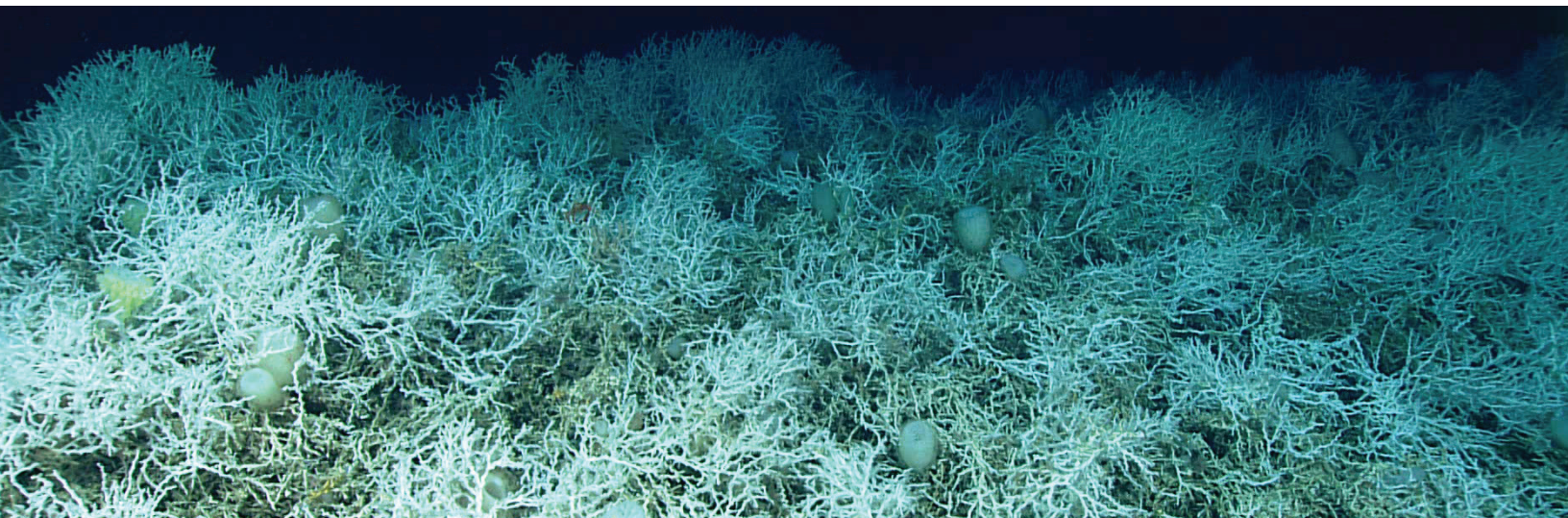
Dense fields of *Lophelia pertusa*, a common reef-building coral, found on the Blake Plateau knolls. The white coloring is healthy - deep-sea corals don't rely on symbiotic algae, so they can't bleach. *Image courtesy of the NOAA Office of Ocean Exploration and Research, Windows to the Deep 2019.*

- Conducted four ROV dives in the Frank. R. Lautenberg Deep-Sea Coral Protection Area, offshore Delaware, Maryland, and Virginia.
  - Found deep-sea corals and sponges on every dive in the protected area, including two sites with high diversity in Wilmington Canyon and Baltimore Canyon.
  - Conducted one ROV dive on a seep site, just south of Norfolk Canyon.
- Conducted mapping and ROV exploration to support Underwater Cultural Heritage (UCH) objectives put forward by the NOAA Sanctuaries Maritime Heritage Program, SEARCH Inc., and the Bureau of Ocean Energy Management (BOEM).
  - Confirmed that a potential target on the Blake Plateau was not the *Bloody Marsh*, an oil tanker lost during WWII.
  - Conducted five nights of focused UCH mapping in the search box for wrecks associated with the Battle of the Atlantic, and an additional survey offshore eastern shore of Maryland and Virginia in search of WWII casualty Olinda, a target identified by BOEM.
  - Additional review of mapping data collected during this expedition is ongoing by the marine archaeology community, and may provide additional targets for future expeditions in the region.
- Collected 166 biological and 12 geological specimens. Biological samples were representative of new records, potential new species, dominant fauna, or were collected to support trans-Atlantic connectivity studies. Geological
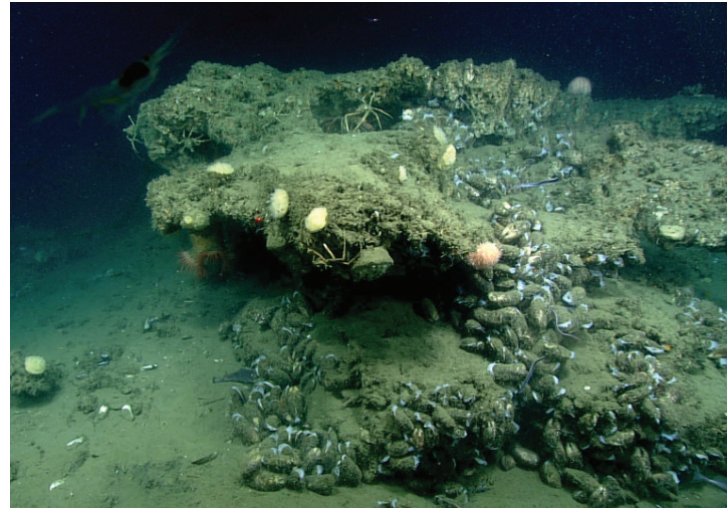
samples will be used to better understand the geologic history of this region, as well as to characterize habitat substrate.

    o   Collected three biological samples to support trans-Atlantic connectivity studies including *Anthomastus* sp., *Lophelia pertusa*, and *Bathymodiolus childressi*.

    o   Deployed a new suction sampler, allowing ROV *Deep Discoverer* to collect mobile fauna for the first time. 30 samples were collected using the new suction sampler, including cephalopods, jellyfish, siphonophores, ctenophores, and difficult to sample associates of deep-sea corals.

Located and characterized deep-sea coral, sponge, and chemosynthetic communities.

- Documented ten dive sites with high biological diversity and observed deep-sea corals and sponges on 18 ROV dives.

- Documented two new seeps sites, one at Bodie Island off North Carolina and another at an unexplored extension of the Norfolk Deep Seep site. At Bodie Island both *Bathymodiolus childressi* and *Bathymodiolus heckerae* mussels were present, creating an extensive mussel habitat, a rarity at this depth (360-415 meters, or ~110-126 feet). Additionally, large authigenic carbonate outcrops were observed, likely indicating that this site has persisted for a long time. At Norfolk Deep, unusual fluid seepage from the seafloor was observed. While similar features have been seen in the Gulf of Mexico, this type of emission was not previously known from the U.S. Atlantic margin.

Large authigenic carbonates were a common observation at the newly discovered Bodie Seep site. *Image courtesy of the NOAA Office of Ocean Exploration and Research, Windows to the Deep 2019.*

- Observed several potential new species, recorded significant
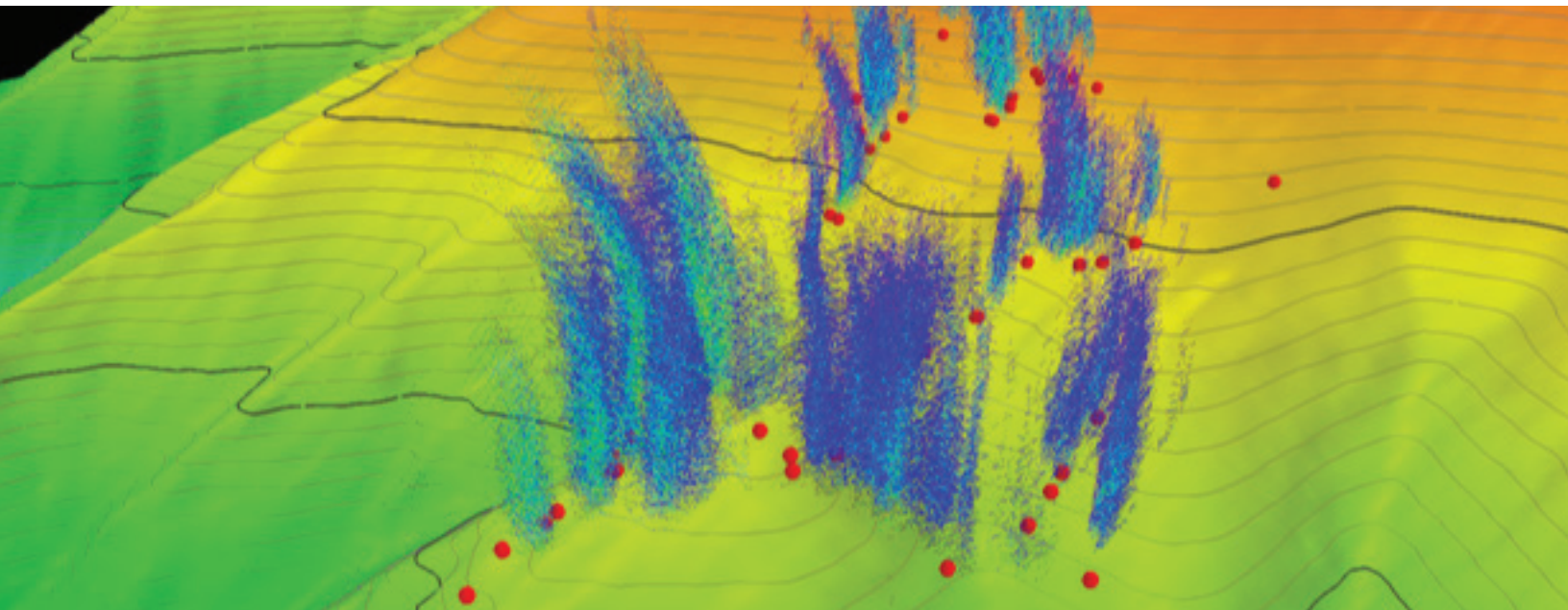
Upslope three-dimensional view of the Bodie Island seeps, with the upper slope bathymetry contoured at 10 meters (~39 feet). Bathymetry is shown with vertical exaggeration. Blue and green clouds in the water column were imaged by the Okeanos Explorer's multibeam sonar and represent acoustic returns from ascending bubbles associated with methane plumes generated at seafloor gas seeps. The red circles on the seafloor are seep locations identified from previous water column imaging. Note that not every previously identified seep was associated with a methane plume during the current *Okeanos Explorer* expedition. *Data collected by the* Okeanos Explorer *and processed by the NOAA Office of Ocean Exploration and Research, with image rendering by A. Skarke.*

depth and geographic range extensions for several species, and documented the presence of commercially important species - including wreckfish (*Polyprion americanus*), Atlantic Roughy (*Hoplostethus occidentalis*), red crab (*Chaceon quinquedens*), golden crab (*Chaceon fenneri*), and a large aggregation of Alfonsino (*Beryx decadactylus*) - in areas not previously investigated.

Extended bathymetric mapping coverage in the U.S. EEZ and international waters in support of Seabed 2030.

- Mapped 28,988 square kilometers (~11,192 square miles), an area larger than the State of Maryland.

- Made new insights in this region, including the discovery of previously unknown mound features in the center of the Blake Plateau. Due to their size, these features cannot be resolved from satellite data and were only revealed in detail using the ship-mounted multibeam sonar.

- Added bathymetric coverage to the Blake Plateau, bringing the total mapping in this area supported by NOAA OER on NOAA Ship *Okeanos Explorer* since 2011, to over 77,400 square kilometers (29,884 square miles), an area larger than the state of Nebraska.

Documented several rarely observed life history events. Highlights included:

- A swordfish fall being devoured by several dogfish sharks, one of which was subsequently eaten whole by a wreckfish in the Stetson Miami Terrace Deep Coral Habitat Area of Particular Concern.

- Numerous observations (~40 individuals) of brooding Warty Octopus (*Graneledone verrucosa*) in the Wilmington Canyon within the Frank. R. Lautenberg Deep-Sea Coral Protection Area.

- First *in situ* observations of mating Jonah crabs at depth in Baltimore Canyon, as well as documentation of several instances of mating *Chaceon* crabs (both red and gold) throughout the expedition's operating area.

- Observation of a *Chaceon* crab eating pallid sculpin (*Cottunculus thomsonii*) eggs.

- Multiple observations of a rare polyphyletic group of starfish feeding on a sponge.
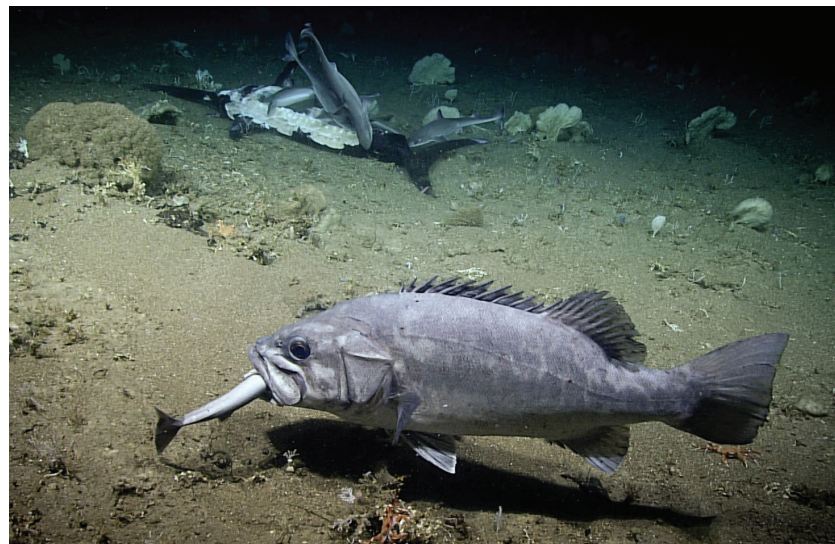
During Dive 07, this wreckfish was observed capturing and eating a shark in the foreground of the billfish. *Image courtesy of the NOAA Office of Ocean Exploration and Research, Windows to the Deep 2019.*

Collected mapping data and conducted ROV dives to support enhanced predictive capabilities for vulnerable marine habitats and submarine geohazards.

- Discovered numerous areas of deep-sea coral and sponge habitat, which has not only improved our understanding of this region, but will also contribute to habitat suitability models. Several areas where dense and diverse coral communities were found were mapped for the first time during this expedition.

- Conducted one ROV dive and detailed bathymetry data over Currituck landslide feature, one of the largest submarine landslides on the U.S. East Coast, to better understand past and potential future submarine geohazards.

- Conducted three nights of focused sub-bottom profiling surveys within the Mid-Atlantic Canyons to gather information about slope stability to inform geohazard predictive capabilities.

Characterized water column habitats using acoustics, visual observations, and emerging technologies.

- Conducted midwater exploration at depths ranging from 300 to 1,000 meters (~984-3,280 feet) during five dives to investigate the diversity and abundance of largely unknown pelagic fauna.
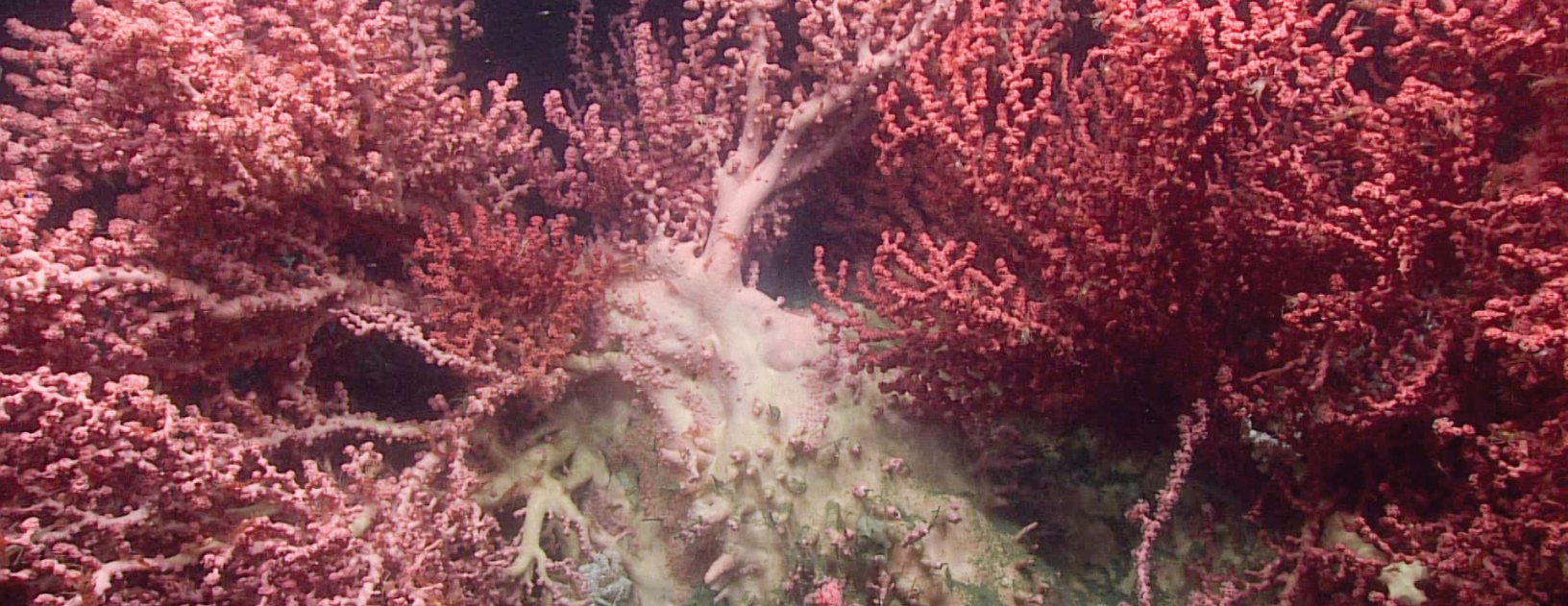
A closer view of the wall of deep-sea corals, mostly bubblegum coral (*Paragorga* sp.), seen towards the end of Dive 18 at Baltimore Canyon during Windows to the Deep 2019. *Image courtesy of the NOAA Office of Ocean Exploration and Research, Windows to the Deep 2019.*

- Conducted one CTD cast and a ROV dive which identified distinct water masses marked by a 4 degree Celsius temperature differential and a high dissolved oxygen concentration on the central Blake Plateau in an area mapped for the first time on EX1903.

Engaged over 130 scientists, resource managers, and students in this expedition through telepresence.

- Participants were from 27 U.S. states and territories, as well as eight international countries including Russia, Portugal, Japan, Germany, Canada, Ireland, Scotland, and Colombia.

Engaged with audiences around the world, opening a window of understanding into the deep sea.

- Conducted five live interactions and two ship tours to engage a diversity of audiences.

- Science leads Amy Wagner and Alexis Weinnig participated in an Instagram Takeover for the American Geophysical Union (AGU) during the expedition, providing viewers with a sneak peek into a day in the life of an *Okeanos Explorer* science lead.

- Over 200 news articles covered the expedition - a record for a single *Okeanos Explorer* mission! Stories about the expedition appeared in national media as well as local outlets in landlocked areas and on both U.S. coasts such as Fox News, CNN, Time, New York Post, HuffPost, BBC, and many more. Media outlets amplified the impact of the expedition, increasing the audience reached, including one repost of the highlight video "Oh My Grouper, Look at that Shark" that received over four million views.

- Live video feeds received over 419,300 views and web content received 129,398 visits during the expedition.

Data collected during this expedition is intended to inform initial characterization of the areas visited and includes multibeam, single beam, subbottom, ADCP, XBT, CTD, and dissolved oxygen profiles; surface oceanographic and meteorological sensors; video and imagery; and physical specimens. All data from this expedition will be publicly available through national archives. OceanExplorer.NOAA.gov will provide a direct link to the expedition data archive once available.

For More Information

OceanExplorer.NOAA.gov/okeanos/explorations/ex1903/welcome.html

Ocean Exploration and Research